AMENDMENTS TO THE CLAIMS

Please cancel claims 18, 21, 24, 27, and 29 to 33, without prejudice or disclaimer of subject matter, amend claims 17, 20, 23, and 26, and add new claims 34 to 52, as shown below. This listing of claims replaces all prior versions, and listings, of claims presented in the application.

Listing Of Claims

1. to 16. (Cancelled)

17. (Currently Amended) A signal output circuit comprising:

a 180-degree phase shifting circuit for shifting a phase of an input signal by an odd multiple of 180 degrees, wherein the 180-degree phase shifting circuit further comprises:

a second operational amplifier having a non-inverted input terminal, an inverted input terminal, and an output terminal,

first through fourth resistors, and

a first capacitor and a second capacitor; and

a first operational amplifier having first and second input terminals and an output terminal, the first and second input terminals having a different polarity,

wherein the input signal is input into the first input terminal ~~terminals~~,

wherein a 180-degree shifted signal output from the 180-degree phase shifting circuit is input to the second input terminal, ~~and~~

wherein a difference between the input signal and the 180-degree shifted signal is output from the output terminal of the first operational amplifier,

wherein the input signal is input to the inverted input terminal via the first resistor, the first capacitor, and the third resistor, and input to the inverted input terminal via the first resistor and the second capacitor, and

wherein an output of the output terminal of the second operational amplifier is fed back to the inverted input terminal via the third resistor, and fed back to the inverted input terminal via

the first capacitor and the second capacitor, and fed back to a signal input side of the first resistor via the fourth resistor and the second resistor.

18. (Cancelled)

19. (Previously Presented) The signal output circuit according to claim 17, wherein the input signal is a wobble signal for rotation control detected from a recording track of an optical disk.

20. (Currently Amended) A signal output circuit comprising: ~~The signal output circuit according to claim 17, further comprising~~

a 180-degree phase shifting circuit for shifting a phase of an input signal by an odd multiple of 180 degrees, wherein the 180-degree phase shifting circuit further comprises:

a second operational amplifier having a non-inverted input terminal, an inverted input terminal, and an output terminal,

first through fourth resistors, and

first and second capacitors, the capacitances of the first and second capacitors capable of being changed in response to a synchronizing signal;

a first operational amplifier having first and second input terminals and an output terminal, the first and second input terminals having a different polarity; and

a phase comparator operable to:

compare a phase of the input signal and a phase of the 180-degree shifted signal; and

output the synchronizing ~~a synchronizing~~ signal for synchronizing the 180-degree shifted signal with the input signal, wherein the 180-degree phase shifting circuit is controlled in response to the synchronizing signal so as to output the 180-degree shifted signal while synchronizing the 180-degree shifted signal with the input signal,

wherein the input signal is input into the first input terminal,

wherein a 180-degree shifted signal output from the 180-degree phase shifting circuit is input to the second input terminal,

wherein a difference between the input signal and the 180-degree shifted signal is output from the output terminal of the first operational amplifier,

wherein the input signal is input to the inverted input terminal via the first resistor, the first capacitor, and the third resistor, and input to the inverted input terminal via the first resistor and the second capacitor, and

wherein an output of the output terminal of the second operational amplifier is fed back to the inverted input terminal via the third resistor, fed back to the inverted input terminal via the first capacitor and the second capacitor, and fed back to a signal input side of the first resistor via the fourth resistor and the second resistor.

21. (Cancelled)

22. (Previously Presented) The signal output circuit according to claim 20, wherein the input signal is a wobble signal for rotation control detected from a recording track of an optical disk.

23. (Currently Amended) A signal output circuit comprising: ~~The signal output circuit according to claim 17, further comprising:~~

a 180-degree phase shifting circuit for shifting a phase of an input signal by an odd multiple of 180 degrees, wherein the 180-degree phase shifting circuit further comprises:

a second operational amplifier having a non-inverted input terminal, an inverted input terminal, and an output terminal,

first through fourth resistors, and

first and second capacitors, the capacitances of the first and second capacitors capable of being changed in response to a synchronizing signal;

a first operational amplifier having first and second input terminals and an output terminal, the first and second input terminals having a different polarity;

a voltage controlled oscillator ("VCO") circuit; and

a phase comparator operable to:

compare the input signal and an output of the VCO circuit; and

output the synchronizing ~~a synchronizing~~ signal for synchronizing the 180-degree shifted signal with the input signal,

wherein the 180-degree phase shifting circuit and the VCO circuit are controlled in response to the synchronizing signal so as to output the 180-degree shifted signal while synchronizing the 180-degree shifted signal with the input signal,

wherein the input signal is input to the inverted input terminal via the first resistor, the first capacitor, and the third resistor, and input to the inverted input terminal via the first resistor and the second capacitor,

wherein an output of the output terminal of the second operational amplifier is fed back to the inverted input terminal via the third resistor, and fed back to the inverted input terminal via the first capacitor and the second capacitor, and fed back to a signal input side of the first resistor via the fourth resistor and the second resistor,

wherein the input signal is input into the first input terminal,

wherein a 180-degree shifted signal output from the 180-degree phase shifting circuit is input to the second input terminal, and

wherein a difference between the input signal and the 180-degree shifted signal is output from the output terminal of the first operational amplifier.

24. (Cancelled)

25. (Previously Presented) The signal output circuit according to claim 23, wherein the input signal is a wobble signal for rotation control detected from a recording track of an optical disk.

26. (Currently Amended) A signal output circuit comprising:

a 360-degree phase shifting circuit for shifting a phase of an input signal by an integral multiple of 360 degrees, wherein the 360-degree phase shifting circuit further comprises:

a second operational amplifier having a non-inverted input terminal, an inverted input terminal, and an output terminal,

a third operational amplifier having a non-inverted input terminal, an inverted input terminal, and an output terminal,

first through fifth resistors, and

first and second capacitors; and

a first operational amplifier having a first and second input terminals and an output terminal, the first and second input terminals having a same polarity,

wherein the input signal is input to the first input terminal,

wherein a 360-degree shifted signal output from the 360-degree phase shifting circuit is input to the second input terminal, ~~and~~

wherein a sum of the input signal and the 360-degree shifted signal is output from the output terminal of the first operational amplifier,

wherein the input signal is input to the inverted input terminal of the second operational amplifier via the first resistor, the first capacitor, and the third resistor, and input to the inverted input terminal of the second operational amplifier via the first resistor and the second capacitor,

wherein an output of the output terminal of the second operational amplifier is fed back to the inverted input terminal of the second operational amplifier via the third resistor, and fed back to the inverted input terminal of the second operational amplifier via the first capacitor and the second capacitor, and fed back to a signal input side of the first resistor via the fourth resistor and the second resistor, and input to the inverted input terminal of the third operational amplifier via the fourth resistor, and

wherein an output of the output terminal of the third operational amplifier is fed back to the inverted input terminal of the third operational amplifier via the fifth resistor.

27. (Cancelled)

28. (Previously Presented) The signal output circuit according to claim 26, wherein the input signal is a wobble signal for rotation control detected from a recording track of an optical disk.

29. to 33. (Cancelled)

34. (New) A noise removal apparatus comprising:

an input terminal configured to receive an electrical input signal from an external source;

a phase-shifting circuit further comprising a phase-shift input terminal electrically connected to the input terminal, and a phase-shift output terminal, the phase-shifting circuit configured to:

shift the phase of the electrical input signal by an odd multiple of 180-degrees to produce a phase-shifted signal, and

output the phase-shifted signal via the phase-shift output terminal; and

a first operational amplifier further comprising a first terminal electrically connected to the input terminal, and a second terminal having an opposite polarity than the first terminal, the second terminal electrically connected to the phase-shift output terminal, the first operational amplifier configured to output a difference signal corresponding to a difference between the electrical input signal and the phase-shifted signal.

35. (New) The noise removal apparatus of claim 34, wherein the phase-shifting circuit further comprises:

a first resistor further comprising an input side electrically connected to the phase-shift input terminal, and an output side;

a second resistor;

first and second capacitors electrically each connected to the output side of the first resistor and the second resistor;

a second operational amplifier further comprising an inverting terminal electrically connected to the second capacitor and the second resistor, a non-inverting terminal electrically connected to a reference potential, and an output terminal fed back to the inverting terminal via the second resistor;

a third resistor further comprising an input side electrically connected to the output terminal of the second operational amplifier, and an output side; and

a fourth resistor further comprising an input side electrically connected to the output side of the third resistor, and an output side electrically connected to the input side of the first resistor.

36. (New) The noise removal apparatus of claim 35, wherein the reference potential is ground.

37. (New) The noise removal apparatus of claim 34, wherein
the phase-shifting circuit is a frequency-controlled phase-shifting circuit.

38. (New) The noise removal apparatus of claim 37, further comprising:
a phase comparator further comprising:
a first input terminal electrically connected to the phase-shift input terminal,
a second input terminal electrically connected to the phase-shift output terminal, and
an output terminal electrically connected to the frequency-controlled phase-shifting circuit, the phase comparator configured to output a frequency control signal via the output terminal.

39. (New) The noise removal apparatus of claim 38 further comprising a third capacitor, the third capacitor further comprising a first side electrically connected to the output terminal of the phase comparator, and a second side, wherein the third capacitor is configured to remove high-frequency noise from the phase comparator.

40. (New) The noise removal apparatus of claim 38, further comprising a voltage controlled oscillator ("VCO") circuit further comprising a first side electrically connected the output terminal of the phase comparator, and a second side electrically connected to second input terminal of the phase comparator.

41. (New) The noise-removal apparatus of claim 38 wherein the frequency controlled phase-shifting circuit further comprises:
a first resistor further comprising an input side electrically connected to the phase-shift input terminal and an output side;
a second resistor;

first and second variable capacitors electrically each connected to the output side of the first resistor, and the second resistor;

a second operational amplifier further comprising an inverting terminal electrically connected to the second variable capacitor and the second resistor, a non-inverting terminal electrically connected to a reference potential, and an output terminal fed back to the inverting terminal via the second resistor;

a third resistor further comprising an input side electrically connected to the output terminal of the second operational amplifier, and an output side; and

a fourth resistor further comprising an input side electrically connected to the output side of the third resistor, and an output side electrically connected to the input side of the first resistor.

42. (New) The noise removal apparatus of claim 41, wherein the reference potential is ground.

43. (New) The noise removal apparatus of claim 41, wherein the first and second variable capacitors have capacitances which are each adjusted by the frequency control signal.

44. (New) The noise removal apparatus of claim 34, wherein the electrical input signal is a wobble signal for rotation control detected from a recording track of an optical disk.

45. (New) A noise removal apparatus comprising:

an input terminal configured to receive an electrical input signal from an external source;

a phase-shifting circuit further comprising a first terminal electrically connected to the input terminal, and a second terminal, the phase-shifting circuit configured to:

shift the phase of the electrical input signal by a multiple of 360-degrees to produce a phase-shifted signal, and

output the phase-shifted signal via a second terminal; and

a first operational amplifier further comprising a first non-inverting terminal electrically connected to the input terminal, and a second non-inverting terminal electrically connected to the

second terminal, the first operational amplifier configured to output a summation signal corresponding to a summation of the electrical input signal and the phase-shifted signal.

46. (New) The noise removal apparatus of claim 45, wherein the phase-shifting circuit comprises:

a first resistor further comprising an input side electrically connected to the first terminal, and an output side;

a second resistor;

first and second capacitors electrically each connected to the output side of the first resistor and the second resistor;

a second operational amplifier further comprising an inverting terminal electrically connected to the second capacitor and the second resistor, a non-inverting terminal electrically connected to a reference potential, and an output terminal fed back to the inverting terminal via the second resistor;

a third resistor further comprising an input side electrically connected to the output terminal of the second operational amplifier, and an output side;

a fourth resistor further comprising an input side electrically connected to the output side of the third resistor, and an output side electrically connected to the input side of the first resistor;

a third operational amplifier further comprising an inverting terminal electrically connected to the output side of the third resistor, a non-inverting terminal electrically connected to the reference potential, and an output terminal; and

a fifth resistor further comprising a first side electrically connected to the output terminal of the third operational amplifier, and an second side electrical connected to the output side of the third resistor.

47. (New) The noise removal apparatus of claim 46, wherein the reference potential is ground.

48. (New) A noise removal apparatus comprising:

an input terminal configured to receive an electrical input signal from an external source;

a first phase-shifting circuit further comprising a first phase-shift input terminal electrically connected to the input terminal, and a first phase-shift output terminal, the first phase-shifting circuit configured to:

shift the phase of the electrical input signal by an odd multiple of 180-degrees to produce a first phase-shifted signal, and

output the first phase-shifted signal via the first phase-shift output terminal;

a second phase-shifting circuit further comprising a second phase-shift input terminal electrically connected to the input terminal, and a second phase-shift output terminal, the second phase-shifting circuit configured to:

shift the phase of the electrical input signal by a multiple of 360-degrees to produce a second phase-shifted signal, and

output the second phase-shifted signal via a second phase-shift output terminal; and

an operational amplifier further comprising an inverting terminal electrically connected to the first phase-shift output terminal, a first non-inverting terminal electrically connected to the second phase-shift output terminal, and a second non-inverting terminal electrically connected to the input terminal, the operational amplifier configured to output an output signal corresponding to a summation of the electrical input signal and the second phase-shifted signal minus the first phase-shifted signal.

49. (New) The noise removal apparatus of claim 48, wherein the operational amplifier further comprises:

a first two-input operational amplifier further comprising an inverting terminal electrically connected to the first phase-shift output terminal, a non-inverting terminal electrically connected to the second phase-shift output terminal, and an output terminal; and

a second two-input operational amplifier further comprising a first non-inverting terminal electrically connected to the output terminal of the first two-input operational amplifier, a second non-inverting input electrically connected to the input terminal, the second two-input operational amplifier configured to output the output signal.

50. (New) A noise removal method comprising:

receiving, at an input terminal, an electrical input signal from an external source;

receiving, at a phase-shifting circuit, the electrical input signal, the phase-shifting circuit further comprising a phase-shift input terminal electrically connected to the input terminal, and a phase-shift output terminal;

shifting, at the phase-shifting circuit, the phase of the electrical input signal by an odd multiple of 180-degrees to produce a phase-shifted signal;

outputting, via the phase-shift output terminal, the phase-shifted signal;

receiving, at an operational amplifier, the phase-shifted signal, the operational amplifier further comprising a first terminal electrically connected to the input terminal, a second terminal having an opposite polarity than the first terminal, the second terminal electrically connected to the phase-shift output terminal, and an output terminal; and

outputting, via the output terminal of the operational amplifier, a difference signal corresponding to a difference between the electrical input signal and the phase-shifted signal.

51. (New) A noise removal method comprising:

receiving, at an input terminal, an electrical input signal from an external source;

receiving, at a phase-shifting circuit, the electrical input signal, the phase-shifting circuit further comprising a first terminal electrically connected to the input terminal, and a second terminal;

shifting, at the phase-shifting circuit, the phase of the electrical input signal by a multiple of 360-degrees to produce a phase-shifted signal;

outputting, via the second terminal of the phase-shifting circuit, the phase-shifted signal via the second terminal;

receiving, at an operational amplifier, the phase-shifted signal, the operational amplifier further comprising a first non-inverting terminal electrically connected to the input terminal, a second non-inverting terminal electrically connected to the second terminal, and an output terminal; and

outputting, via the output terminal of the operational amplifier, a summation signal corresponding to a summation of the electrical input signal and the phase-shifted signal.

52. (New) A noise removal method comprising:

receiving, at an input terminal, an electrical input signal from an external source;

receiving, at a first phase-shifting circuit, the electrical input signal, the first phase-shifting circuit further comprising a first phase-shift input terminal electrically connected to the input terminal, and a first phase-shift output terminal;

receiving, at a second phase-shift input circuit, the electrical input signal, the second phase-shifting circuit further comprising a second phase-shift input terminal electrically connected to the input terminal, and a second phase-shift output terminal;

shifting, at the first phase-shifting circuit, the phase of the electrical input signal by an odd multiple of 180-degrees to produce a first phase-shifted signal;

shifting, at the second phase-shifting circuit, the phase of the electrical input signal by a multiple of 360-degrees to produce a second phase-shifted signal;

outputting, via the first phase-shift output terminal, the first phase-shifted signal;

outputting, via the second phase-shift output terminal, the second phase-shifted signal;

receiving the first phase-shifted signal at an inverting terminal of an operational amplifier;

receiving the second phase-shifted signal at a first non-inverting terminal of the operational amplifier;

receiving the electrical input signal at a second non-inverting terminal of the operational amplifier; and

outputting an output signal corresponding to a summation of the electrical input signal and the second phase-shifted signal minus the first phase-shifted signal.